

INTERDISCIPLINARY RESEARCH IN PHYSICS

John C. Harlett

Applied Physics Laboratory

University of Washington

1013 NE 40th Street

Seattle, WA 98105

Phone: (206)543-1366 Fax: (206)543-3521

harlett@apl.washington.edu

Grant N00014-96-1-0246

LONG-TERM GOALS

From ONR's creation of this program in 1979, APL-UW's goal has been to pursue high quality fundamental research which brings together APL staff and University of Washington academic unit principal investigators in new collaborations, ultimately leading to a fuller participation of the Laboratory in research and supervision of graduate students and post-docs. A secondary goal is to establish continuing collaborative research programs which access expertise and facilities at the University of Washington which have otherwise not been applied to Navy-related problems.

RESEARCH COMPONENTS

PROPAGATION OF ELECTROMAGNETIC FIELDS IN THE COASTAL OCEAN WITH APPLICATIONS TO UNDERWATER NAVIGATION AND COMMUNICATION

Thomas B. Sanford and Robert H. Tyler (APL), Martin Unsworth (Geophysics)

We have examined the propagation of low-frequency electromagnetic waves in the coastal ocean produced by controlled or motional impressed sources. Results have been obtained both analytically and from a finite-element numerical model. We have focused on characterizing several new effects such as a 'beach' propagation mode which have not previously been described in the literature. These results have been written up and are currently under review for the journal *RADIO SCIENCE*. In this paper we also discuss the importance of our results in designing navigation and communications applications for subsurface vehicles and instruments. This project supported a post-doctoral investigator (Tyler).

Report Documentation Page			Form Approved OMB No. 0704-0188	
<p>Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</p>				
1. REPORT DATE 30 SEP 1997	2. REPORT TYPE	3. DATES COVERED 00-00-1997 to 00-00-1997		
4. TITLE AND SUBTITLE Interdisciplinary Research in Physics		5a. CONTRACT NUMBER		
		5b. GRANT NUMBER		
		5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S)		5d. PROJECT NUMBER		
		5e. TASK NUMBER		
		5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) University of Washington, Applied Physics Laboratory, 1013 N.E. 40th Street, Seattle, WA, 98105		8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)		
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited				
13. SUPPLEMENTARY NOTES				
14. ABSTRACT				
15. SUBJECT TERMS				
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 3
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified	19a. NAME OF RESPONSIBLE PERSON	

ANALYSIS AND SYNTHESIS OF PHYSIOLOGICAL TIME SERIES USING FRACTALS

Donald B. Percival (APL), J.B. Bassingthwaigte (Bioengineering), Per Reinhard (Mechanical Engineering)

The focus of this effort is to develop ways of analyzing and synthesizing time series exhibiting fractal (self-similar) characteristics, with particular emphasis on their use with biomedical time series. We have investigated two new techniques for analysis (the scaled windowed variance and the wavelet variance) and are currently completing a paper that compares the statistical and computational properties of various synthesis techniques (in particular, the Davies-Harte method and a frequency domain method). This project supported a graduate student.

NUMERICAL MODELING AND LABORATORY TESTING OF SONOELASTIC IMAGING TECHNIQUES

Daniel Rouseff (APL), Roy Martin (Bioengineering)

An ordinary diagnostic medical ultrasound device relies on a contrast in acoustic impedance between a scatterer and the background to get a backscattered signal and produce an image. Sonoelasticity is an attempt to image based on contrasts in tissue stiffness and thus distinguish targets not accessible with conventional ultrasound. This is accomplished by applying stress to the medium. Our work has focused on using low frequency (less than 20 Hz) vibration for tissue deformation. At these frequencies, Doppler data acquisition can be synchronized with the vibration source to avoid aliasing. Measured changes in velocity within a sample are then mapped to changes in shear modulus. A possible long-term application of the technique is to detect internal bleeding. Laboratory experiments have detected a blood-mimicking fluid embedded in an agar phantom. Numerical simulations have studied alternative methods of velocity detection. This project supported a graduate student.

INTELLIGENT OCEANOGRAPHIC AGENTS

Gregory Anderson (APL), O. Etzioni (Computer Science and Engineering)

The focus of this research has been to develop intelligent agent and workflow management tools that: (1) automate collection of meteorology and oceanographic information from the worldwide web, and (2) manage the flow of information to and from tasks in Navy METOC office tactical missions. An intelligent agent developed as part of this research, named "Flipper", is functioning and has been integrated with METOC workflow tools. To accurately understand and define METOC office information and processing requirements, the investigators established close liaison with the Commanding Officer, Navy Meteorological and Oceanography Facility, NAS-North Island, and his staff. Extending the scope of the research project, we also aided this office in their development of a

concept for a smart METOC center. This project supported both graduate and undergraduate research.

SURFACE AND STORMWATER ASSESSMENT OF BANGOR SUBMARINE BASE

Christopher May (APL)

The overall goal of this project was to improve water quality and enhance the ecological integrity of aquatic resources located within the Naval Submarine Base, Bangor. A specific objective of this study included the assessment of the current condition of aquatic resources, especially the native salmonid populations utilizing on-base streams, wetlands, and lakes. Based on this assessment, an in-stream habitat enhancement and rehabilitation plan was developed. A second objective of the project was to evaluate the existing stormwater management infrastructure, to include structural best management practices and non-structural components. Based on this evaluation, an integrated surface and stormwater management plan was developed. This plan is built around a watershed-based, resource-driven approach for protecting aquatic ecosystems from the impacts of human activities. This plan could serve as a model for other Department of Defense facilities in the Pacific Northwest region and could be adapted to other areas of the country. Application of new, innovative technologies for stormwater treatment and non-point source pollution control was a high priority.